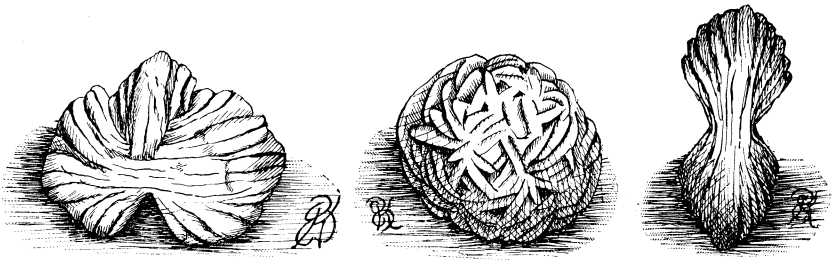
tents in the mud where the balls of hide thongs became petrified in the course of time. No mystery of natural formation in Kansas can be so deep but that it may be thoroughly cleared up, it seems, by the aid of the Indians and a cyclone.



Others explain these concretions by calling them petrified potatoes; but they fail to tell us who planted the potatoes. A chemical analysis of one specimen gave the following results:

Silicic acid	43.71	per cent.
Barium sulphate	46.60	"
Strontium sulphate	4.20	"
Aluminum oxide	5.00	"
Ferric oxide	.52	"
Potassium oxide	.20	"

The concretions, therefore, seem to be quartz sands cemented together by barium sulphate admixed with a little strontium sulphate. The specific gravity is 3.36. They vary in size from that of a chestnut to that of a baseball, are somewhat flattened, and are apparently made up of a series of plications.

CONCRETIONS.

BY E. B. KNERR, ATCHISON.

Read before the Academy December 30, 1898.

A concretion, literally, is a "growing together." Taken in its fullest significance it is, indeed, a very broad term, and we would find classed under this term all assemblages showing symmetry of structure, such as crystals, geodes, nodules, molecules, cells, and even life-forms. In fact, any structure which results from an aggregation of material about a nucleus may properly be called a concretion. Verily, the philosophy wrapped up in the homely proverb, "Birds of a feather flock together," is deep and far-reaching in its import. Could we explain fully the forces at play in the formation of a snowflake, how very much would our knowledge be extended beyond what it is to-day. Could we tell just how and why the water molecules are arranged every time along the hexagonal axes, we would know what the atom is, what the molecule is, what ions are, what the so-called positive and negative electricities are, what chemical affinity is, what gravity is, aye, even what life is.

This may seem to some a broad assertion, but the principles underlying the formation of a water crystal are the same for all crystals and all aggregations of crystals. But the same substances under like conditions always crystallize in the same forms; the structure of the molecule must therefore have something also to do with the crystalline form, and so we must understand the invisible molecule in order that we may fully understand the visible crystal. But again,

the molecule depends upon the arrangement of its constituent atoms, and that in turn upon their constitution and nature and the forces at play upon them; so we must understand the atom in order to understand the visible crystal. When we shall know all this, and the driving force which impels atoms and molecules to their manifest results as symmetrical structures and organisms, who will say that we will not understand not only what light is, and electricity, but also what gravity is, and life? Our present fund of knowledge, great as it is, will be considered small indeed as compared with what it shall be then.

As a few possible hints in the direction of such knowledge, I desire to direct your attention to some concretionary forms which I shall use by way of illustration. There is an undoubted unity in the universe, one pervading principle. Indeed, the word "universe" means that very thing: all "turned to one." All facts, then, rightly comprehended, must lead toward the solution of this great problem which we have suggested.

We will first consider the structure of the "pillow-witch." A "pillow-witch" is an aggregation of feathers formed sometimes in pillows by the feathers accumulating about a nucleus or center. A few hairs will first work their way into the pillow; these will become more or less tangled under the continual movement of the contents of the pillow when in use. The feathers will always be worked in the same direction; that is, with the shaft forward. The tangled hair will arrest a few, others will be crowded in between these, always being forced into the bunch with the shaft forward. Because of the curved structure of each individual feather, the resulting concretion will be symmetrical in form, and every constituent feather will point to the nucleus.

Very similar in structure are the hair balls taken occasionally from the stomachs of cattle, and resulting from the accumulation of hair swallowed in the act of licking other cattle. If we cut into one of these balls we will find the short, curved hairs arranged approximately parallel and pointed to a nucleus, just as in the case of the feathers in the pillow-witch. A few tangled ones formed a nucleus at first, then under the churning action of the stomach others were driven end first into this mass. This is indicated by their parallel arrangement. After the shedding season is over, and hair is no longer swallowed in considerable quantities, a slimy deposit of salts begins to form over the outside, which hardening renders the ball impervious to the entry of other hairs, thus determining its size and structure.

Now, may not crystalline aggregates such as calcareous, pyrite, and flint nodules, and even crystals themselves, result by an analogous process? There are certain facts which indicate such to be the case. Too violent an agitation of the pillow will cause the outer layers of feathers to break away from the "witch," thus tending to make balls of only small size. Likewise in the formation of crystals from solutions, the crystals will always be small when obtained from hot solutions; that is, from solutions where the molecules are in violent agitation because of the high temperature. Large crystals are obtained only from cold solutions, where the agitation is relatively mild. In their formation we find the molecules are pressed toward centers or nuclei, just as the feathers were pressed toward the "witch" nucleus, by the motion of the surrounding matter.

The "pillow-witch" required a nucleus of tangled hair or broken feathers or other foreign material. It is a well-known fact that crystals also form more readily if dust or other solid particles be in the solution. Indeed, with certain degrees of concentration they fail to form in the absence of foreign solid particles, but the moment these are added crystallization begins. When it is desired to obtain large crystals of any salt the solution is concentrated to the right degree, a

small particle of a crystal of the substance is dropped into the solution, and a crystal at once begins to grow about this as a center, just as the feathers accumulated about the tangled hair as a center. How very minute, though, must be the meshes to entrap the first molecule!

Another analogous aggregation is the condensation of moisture about dust particles in the atmosphere, thus starting the formation of the fog or cloud vesicles from which grow the raindrops. By the same principle a thin film of moisture is collected on every surface, no matter how dry apparently it may be; and each surface has its own entrapping power, from that of a quartz crystal where the film is inconceivably small, to the hygroscopic surface of a calcium chloride crystal where the accumulation of water is so rapid as to become visible in a few seconds.

Now, may we not go a step further and look for an analogous structure in the molecule? The theory of the molecule is that it is an aggregate of atoms suspended in an agitated medium — the ether. By the vibrations continually running through the ether the atoms are crowded to centers, thus constituting molecules. The nature of the molecule will depend upon the size, form, and weight of the atoms. These are fixed qualities of the atom; hence the resultant molecules are always the same. The apparent exceptions in the case of the allotropic forms of carbon, sulphur, and phosphorus may be explained by several arrangements being possible, though some particular one is more likely than another, as in the case of pyrite, which commonly occurs in cubes though sometimes in octahedral and dodecahedral forms. By such an hypothesis we have an explanation of chemical affinity. Chemical affinity under this view is a driving of such atoms together which most perfectly fit together in the molecule. Should another set of atoms as a reagent be introduced, they may be so constituted as to fit more perfectly with the present set than these do among themselves, and at once a reaction takes place, with a new arrangement as a result. Possibly the tendency toward rearrangement is too feeble to produce any result under the ordinary disturbances of the ether, and some special vibrations must be introduced, as when chlorine is helped to decompose water in sunlight. Here we may also find an explanation for chemical energy, by accounting for it as residing in the ether movement which binds the fitting atoms together into the symmetrical molecule. We can also account for the heat which results from chemical reaction by regarding it as the energy of the motion of the atoms as they come together being transformed into the energy of agitation of the new molecules, which is heat.

When the darkeys find feather balls in their pillows they believe that they have been hoodooed, and they find in the "pillow-witches" an explanation of all their ills and misfortunes. Why should not the chemist find in them also a solution to many of his perplexities.

VARIATIONS IN THE NITROGEN-CONTENT OF MAIZE, AND POSSIBILITIES FOR IMPROVEMENT OF IT.

BY J. T. WILLARD, MANHATTAN.

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That plants vary, and that it is because of this variation that improvement is possible, is a fact known to every student of science. That chemical differences should be present in individuals which present no external differences could not be assumed, and by many would not be suspected. Twelve years ago the author